

# blenderart

## 3D Printing !

How to become a successful Blender Shapeways designer

Using the 3D print for the products design and fine arts

100 hours of print time and what I have learned

How to learn "learning"

Pirate - by Ben Dansie

# blenderart

**EDITOR** - GauravNawani

**MANAGER/EDITOR** - SandraGilbert

**WEBSITE** - NamPham

**DESIGN** - GauravNawani

## PROOFERS

Charlie Shene

Fade Shayol \*

Scott Hill

Brian C. Treacy

Bruce Westfall

Daniel Hand

Daniel Mate

Henriël Veldtmann

Joshua Leung

Joshua Scotton

Kevin Braun

Mark Warren \*

Noah Summers

Phillip Ryal

Ronan Posnic

Wade Bick \*

## WRITERS

Richard Borrett

Dreamsgate

Metalnat Hayes

Joris Verbeken and Virginie Peeters

Dolf Veenvliet

Chris Yonge

Krzysztof Bozalek

Ben Dansie

Shigeto Maeda

Orest B

Hakkı Rıza Küçük

## COVERART

The Trip - by Anurag

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# EDITORIAL



**Sandra Gilbert**

Manager/Editor

**Technology has advanced to the point where you can print out your "something".**

Back when I got into 3D I thought it was the coolest thing in the world to start with a blank screen and create a "something". And the cool part was that I could turn it and view it from any angle. I was no longer limited to just one view and I didn't have to "draw / paint" multiple angles. I could just move the camera and "ta dah", new image. Seriously awesome.

Well now that awesomeness has grown to a whole new level. Technology has advanced to the point where you can print out your "something". Yes, that's right, print it out and actually hold it. That just makes me want to "happy dance" all over

the office. :)

There are several companies that offer 3D printing services as well as a number of affordable 3D printers for those of us that simply can't live without one.

So why would you want to print out your 3D models? Well, beyond the obvious "coolness" of simply being able to print it out and play with it?

There are unlimited uses. You could prototype new products as well as print and sell actual products in a growing number of materials. Everything from jewelry to smart phone cases and quite a few unusual and unique items as well.

If you can create / model it, you can print it out as long as you take into consideration the printing specifications for your chosen material.

But where and how do you get started? Well that is exactly what we will be looking at in this issue. So gather close as we delve into the exciting world of "3D Printing".

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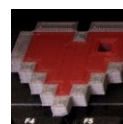
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# IZZY SPEAKS

the truth and nothing but the truth



## 3D PRINTING OF BAM LOGO

**A** clueless – wonder's guide to 3D printing. And when I started this project I was definitely clueless. I mean I did have a general working understanding of what was needed. Design a model, send it to a 3D print service like Shapeways and wait for it to arrive in the mail.

A rather simplistic understanding of course, but it was enough of a start to get me going.



### PLANNING STAGE:

Any project requires at least a bit of planning. First you need to decide exactly what you are going to model and print. That in itself can be a real show stopper. For my first 3D printing project I modeled our BAM logo.

Now, you may have noticed the BAM logo is rather long and rectangular and really not that complicated. But it is mostly text, something I am not overly fond of modeling. Luckily for me, I have an SVG of our logo which took most of the pain out of modeling it. Once imported into Blender, there was a bit of clean up involved, but fairly quickly I had a simple 3D version of the BAM logo. It was simple, clean and frankly, not overly inspired. So it was time to stop and do a bit of that planning thing.

After giving it some thought, I decided our logo was just too long and unwieldy. Then I remembered that we have an alternate logo that we use on our Facebook page. That might make a better starting

point. After tossing a few ideas around, I hit upon trying to make it look like it had been carved out of a large stone. I Googled a bunch of images of carved stone signs for reference and a concept started taking shape.

Since I had already modeled the original BAM logo, it was a simple matter of grabbing the "B" and "A" and starting from there. I decided to delete the "mag" part of the logo (I didn't think it would show up well since it is so small compared to the rest of the logo). A couple of hours later I had a reasonable looking carved stone logo. It probably would have taken considerably less time if I hadn't spent so long playing in sculpt mode. Sculpting is seriously addictive fun!

### UPLOAD STAGE:

This probably should have been done before the modeling, but now I decided to go look at the specs for the material I was going to use, in this case Full Colored Sandstone. The part that stuck out the most was the "sandcastle rule". If this structure was made of wet sand, would it break?

Hmmm, does that mean it needs to be solid? A quick email to Bart answered that question. Not at all. It can be hollowed out but the walls must be thick enough to support it, in this case the walls would need to be at least 3mm thick.

Well, that meant it was time to go back to Blender, because I currently have a solid object. Not ideal, since the pricing is done on volume. So a quick extrusion up into the model from the bottom should do it. Yeah, kind of.

Bart did suggest using MeshLab to check my model before uploading, so I downloaded the program, exported my amazing creation and opened it in MeshLab and had absolutely no idea what to do from

# IZZY SPEAKS

the truth and nothing but the truth



there. Cluelessness strikes again. A bit of poking around did let me see my model from all angles and see the size and thickness of it, but that is all I could figure out. I am sure that MeshLab is a great program, but I would need to spend a fair amount of time trying to figure it out. So I went back to Blender where I am most comfortable to check wall thickness, size and if I had any non-manifold issues. Naturally there were issues that I needed to address before I uploaded my model. Did you really expect there wouldn't be?

Non-manifold issues were revealed by pressing CTRL+ALT+M. Luckily there were only a few which I fixed up. Next was sizing. When I actually checked how big my model was I was seriously surprised. I hadn't given any real thought to size while modeling so it was HUGE! In fact big enough to be a small ornament in my garden. Serious re-scaling down to a more manageable size was required. I think I settled for about 4-5 inches high.

Okay time to upload it to Shapeways. First you need an account, which is very easy to set up, then upload your model. The dialog for uploading is very simple to use. Then you wait and get an email that states:

Hi ,

We just received the successful upload of your product 'BAM\_3D\_print.x3D'. We will now run some automated checks to see if your product can be printed.

When your product is fine you can find it in your 'My Shapeways' section and you will be notified that your product is printable.

When your product can not be printed you will receive an e-mail with the error we found.

We will get back asap to you with the results of the checks.

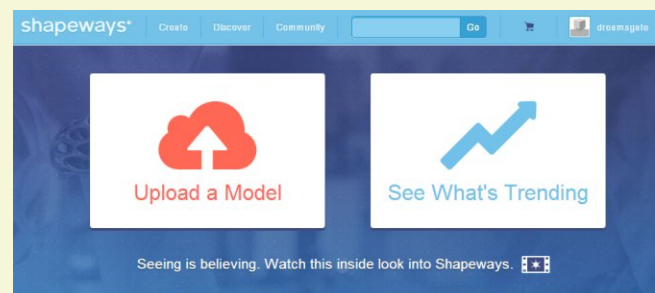
Now honestly I have no idea how long it took for them to check my model because I wandered off for

a cup of coffee and completed a few household tasks. Next time I checked my email, there was a new email letting me know that my model was now available in the "My Models" section of my account.

Yay, time to check it out and look at prices. Whoopsie, I may have wanted to size that model a bit smaller. Full color sandstone was going to cost over \$300.00.

Now is a good time to discuss sizing and pricing. Models are priced on volume not size, so any model that is pretty solid and fairly big it is going to cost more than if it was either smaller or less solid.

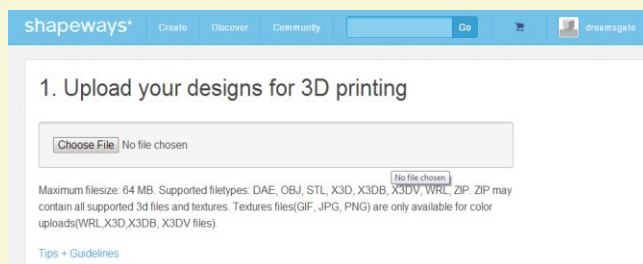
Since my model was a fairly solid object, I opted for thinning the walls and reducing the size to about 2 inches, which actually will fit on my over crowded desk much better anyhow. :P





# IZZY SPEAKS

the truth and nothing but the truth



After uploading and waiting for it to be ready for viewing/ordering, I now had a model that would only cost a little over \$17.00. Reducing the size and volume made a big difference in price. So I went ahead and placed my order. Now all I had to do is wait for it to arrive.



About two weeks later my model arrived in the mail. I was super excited to see how it turned out. It was **TOTALLY AWESOME**. I love the way Full Color Sandstone looks and feels. And the material really went well with my model. It gave it added dimension as a carved stone. In fact I am highly considering modeling a bunch more stones and small ornaments and creating a desk top zen garden. I think it would look amazing.

All said and done, I have decided there is nothing cooler than actually holding something you modeled in your hands and getting to look at it from all sides. The process was not as hard or scary as I had imagined it to be and it is something that I will be exploring further in the near future.

So if you have yet to take the 3D printing plunge, I encourage you to give it a try.



It is a fun and pretty easy process that results in cool objects arriving in the mail. :P ■

## UPCOMING - ISSUE 41

### IMAGINE THE POSSIBILITIES

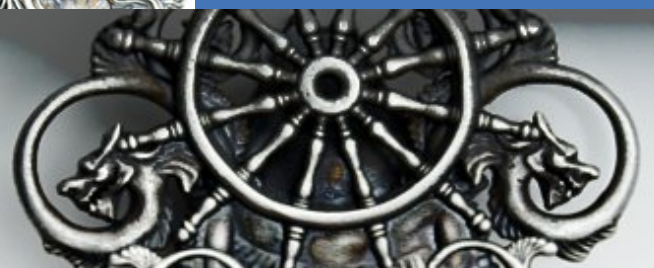
A new year has arrived filled with possibilities for artistic growth and learning. In this issue we are going to look at your personal projects and goals for 2013. What do you hope to learn or accomplish with blender this year. The possibilities are endless, so let the possibility party begin.

- Looking for tutorials or "making of" articles on:
- Personal Projects/Creations
- Any tool or technique

Again way to go on the masters level!!!!

# 3DWORKSHOP

Learning blender the easy way



Printed Pirates

## Ben Dansie

Contributing Author

Using current technology to realise an imagined relic of seafaring history.

### INTRODUCTION

3D printing is something that I would recommend every CG artist tries at least once if they have the chance. There is the usual safety net of copy, save, undo and all the other uniquely digital concepts we take for granted. However, at the end of the process you have the satisfaction of being able to hold and admire the fruit of your labours in a physical form. Renders can be beautiful, but if you haven't engaged in much traditional artwork before, it is really quite something to see your work outside of the context of a screen.



It is also a chance to create items that would be very difficult or near impossible to create any other way. Overlaps, interlocking parts, small areas a knife couldn't possibly fit and scaled detail that would be ridiculously hard to carve by hand.

This article will cover a range of processes involved in printing a metal pendant, but most of the information should apply to 3D printing in general. It is also worth mentioning that this is not a detailed modelling tutorial. With that in mind, let's begin!

### INSPIRATION AND DESIGN

I knew I wanted to do pirate themed pieces when I started. I also knew I didn't want to just sit down and model the first thing that came to mind. I've done that before and it never comes close to what I have in the back of my imagination. Given that I had some time off work I threw myself into a range of inspiration. Books, forum threads, films, music, games and more. Thanks to the likes of Geoffrey Rush, Dominic Armato and Kermit the Frog, I was all set to start with the pencil.

Pencil? This is a computer graphics magazine, isn't it?

I do thoroughly enjoy using my Wacom tablet for texture painting, but I still find myself far more comfortable with an actual pencil when it comes to fleshing out designs and ideas. Given that this was a personally directed project, I had the complete luxury of going about the tasks exactly as I wanted. So pen and



Fig. 1: Front and side views of facial model in Blender.

# Printed Pirates

pencil it was. While watching pirate films and eating cheesecake of course. I love the design phase...

After brainstorming a list of all things buccaneer and trying a few, I decided to go with a female pirate captain. The inspiration just seemed to flow that way. I avoided doing the ring design because I wanted to have the end result for sale on Shapeways and selling different ring sizes was something I still needed to research. I tried the earring design, but the long curved attachment at the top worked far better in 2D than it did in 3D. So I revisited the design and thus the pendant showed itself.



If I had simply thought 'pirate' and started out in Blender, I wouldn't have come anywhere near this line of thought.

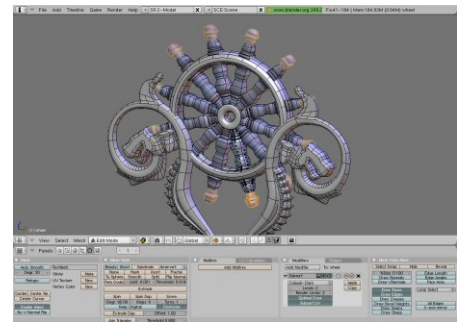
## MODELLING

From here I was ready to get into the modelling. All of the base meshes were completed in Blender and the sculpting was done in Zbrush. Blender's sculpting tools are gaining ground for sure, but as a Zbrush owner I'm quite happy to use it when appropriate. I'd love to decide one day that clay and a huge 3D scanner were the right tools for the job, but somehow I lack the funds for a huge 3D scanner. (If someone has an article about high detail, home-brew photogrammetry, I'm all ears.)

Often I'll feel free to deviate from my own concept art and just use it as a starting block, but I was already happy with the feel of the sketches and wanted to at least keep the overall forms as intact as possible. To keep the silhouette, I traced the outline of the pirate in the initial sketch with vertices and extruded in from

there. I considered actually modelling the base of each major hair curl with proper topology, but that would have taken too much effort for too little reward in the end. Good topology can help with the sculpting process for sure, but when your end result is sterling silver that you can polish, polygons don't enter into it as much. (Side note: Deliberately printing a low poly mesh can have an interesting effect if you want to go that route.)

While it was clear that I wanted to predominantly sculpt the head and poly model the wheel, the serpents were



certainly a mix of both. Once all the components were together and scaled correctly to fit with one another, I gave the whole thing a subtle 'nudging' pass. Deliberately moving parts around slightly to break up perfect curves, giving a slightly more handmade look to the final result.

It is also important to keep physical structure in mind during the modelling process, not just as something you check for afterwards. Are you printing in metal? Plastic? Does it need to hold or support anything? This project was always going to be in metal. I've worked with Sterling Silver before, so while I'm certainly no silversmith – I had a reasonable idea of what details would show up and how strong certain parts needed to be. Structurally it just needed to hold its own weight on any of the top curves that the wearer decided to attach a chain, most likely the outer two serpents.

What I needed to keep an eye on was the volume of the piece more than the strength. Too thick and the final silver piece becomes very heavy and quite expensive. That being said I did have to keep an eye on the minimum detail size as well. A general note though



# Printed Pirates

(which is reiterated on the Shapeways website) is to take a step back and remember just how small one millimetre for example actually is in real life.

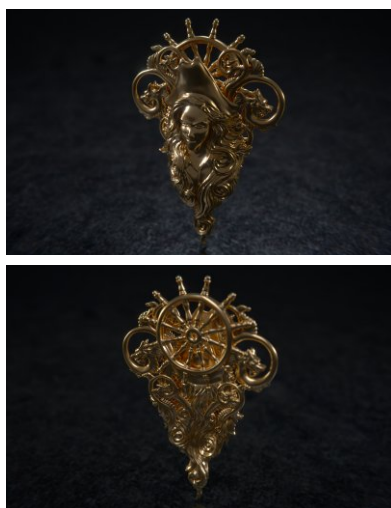


Something might look a bit nicer on your screen if it is half the thickness, but even if the printer could handle it, would you really be able to see sculpted eyelashes at a width of 0.1mm? Given that I love details I had to remind myself of this a lot.

## IF IN DOUBT, EXAGGERATE THE DETAILS A BIT MORE.

Another way to keep overall volume down is to mess with proportions somewhat. While the pirate looks to have a reasonable proportions from the front view – the side view is somewhat flat, lacking the “proper” depth. Not too exaggerated, but scaling back the depth of the overall piece saved on a fair bit of volume which saves weight, materials and price in the end.

For more modelling and sculpting specifics, there are many, many tutorials out there by a number of talented artists in many fields. Remember, just because a tutorial uses Zbrush or Mudbox, that doesn't necessarily mean it can't be completed in Blender. Most of the brushes I use are standard, flatten, pinch, inflate and smooth – all of which are in Blender.



I also found that Cycles and its ability to effortlessly render nice looking metal materials came in handy for visualising the final piece. I'm used to deciphering forms from wireframes, OpenGL previews, ugly video compression and all sorts of digital representation. A good quality render can help a lot though, particularly with metal reflections and getting a feel for how light will interact with your physical print. Not a necessary step in the process, but a handy one to have up your sleeve.

## PREPARING THE MESH FOR 3D PRINTING

This part of the process can take as little as five minutes or it can drag out to be a real source of frustration. Expect some trial and error, especially if it is your first piece. Don't let this section of the article put you off printing because there are a number of design guides out there to help you avoid the pitfalls.

If you are planning to use a service like Shapeways, grab all the information you can directly from their website – material properties, design rules, file types and so on. In the case of Shapeways there is a user forum which is also a great resource for artists starting out on their 3D printing adventures.

If you have modelled your mesh poly by poly all in the one program and you know your face normals are all facing outwards then congratulations! You're probably halfway there already. If you have swapped the mesh in and out of a few file formats, used mesh optimising tools (eg. decimate), booleans or just sculpted to your heart's content without taking mesh structure into account at all – you probably have some clean up work to do. Never fear though, there are a range of free (some as in speech, some as in beer) tools to help you out.

<http://www.click-to-fit.de/easyfit.php?&lang=en>

<http://meshlab.sourceforge.net/>

<http://www.netfabb.com/basic.php>

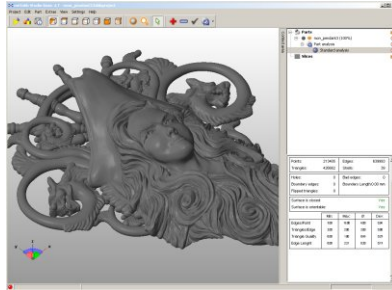
All three of these have their uses, but I found netfabb Studio Basic to be the most



# Printed Pirates

helpful for what I needed it to do.

After exporting your model from Blender (most likely a .stl file, but others are accepted by netfabb), you can perform an automated analysis of the basic details such as volume,



length and area. These are all handy details and can help you keep an eye on weight and cost, but it is the other checks like bad edges, flipped triangles and holes in the mesh that these programs can detect and fix for you that make them really valuable. You can also perform simple operations like scaling and translating the mesh. Obviously if you have kept a tight eye on scale already this is not really required, but it is helpful if you decide your model is just a little too wide for a certain use or just out of your budget for weight or cost.

If the analysis points out any errors, there is a repair option which is fairly easy to use. The defaults will usually do the trick, but options are certainly there if you need them. I always find it worth manually checking the mesh after running any sort of automated process. This goes for any piece of software. It is a force of habit for the most part, but you never know when a sculpted eye socket might be detected as an error and clumsily filled in by the software. It is far better to check for it now as opposed to when your print finally arrives in the mail!

After the mesh is checked overall for being acceptable for the printer, it is time to check the thicknesses for strength. There is a measuring tool in netfabb, but I find the EasyFIT one to be very efficient to use. Check with the printing guidelines (on Shapeways, or for the printer you will be using) and start measuring the smaller more delicate parts of your design - if any.

There is one more thing worth mentioning in this section in regards to the pendant. The structure of the mesh is made up of multiple overlapping closed surfaces (hulls). Be sure to have the overlapping sections solidly overlapping, not simply touching edges.

Initially I thought I would need to have one single continuous mesh for the entire printed piece. This would have either required some heavy boolean work, some work with the awesome remesh modifier in Blender or a whole lot of fancy re-topology and shrinkwrap modifier madness. I almost went with the remesh option, but I was able to print at Shapeways with the multiple overlapping and watertight meshes. If the meshes are simply touching and not overlapping by a strong enough amount, they will simply fall off during the print process.

There might be more checks you have to do depending on your design, but in most cases you should now be ready to send on to the printer!

## SHAPEWAYS EXPERIENCE

This part in theory is quite straight forward, but depending on how thorough you were preparing your mesh for printing you might have some trial and error here too. This time I had far less back and forwards than with my first few Shapeways prints, but the customer service team are quite helpful if your mesh is refusing to print or upload. After a bit of practice you should be able to simply upload your model, choose the material and order away!



Depending on the intricacy of your design and the expense of the final print, you might want to order it in one of the cheaper materials first. The flip side of that for international customers is the shipping can seem like forever when you are eagerly awaiting your print

# Printed Pirates

on the other side of the planet. Not that it is the fault of the print company in any way, it's merely a human patience thing. Of course, if you own a decent 3D printer at home or at work - you're laughing. For the rest of us though, patience is a virtue.

My gold plated steel version of the print arrived first because the silver version was knocked back due to polishing issues. This also split the shipping into another fee, which was less than ideal. I was as happy as could be expected with the quality of the printed steel. A bit of a 'sunken treasure' sort of feel about the surface quality, which doesn't hurt with this particular theme. It was always the silver one I was anxious to see though. Looking at the package tracking data was interesting as it shipped from city to city, but I think it actually had the effect of making the wait seem longer.



Finally the silver version arrived at work and the package was eagerly opened and proudly shown around the studio. Definitely happy with the end result on that one, the surface details are immensely better than the steel. Again, it differs per design and per material but you may need to polish / sand / clean up your print once it arrives, but some designs benefit from the printed texture.

## PHYSICAL POST PRODUCTION

It was suggested on the Shapeways forum that I

should try and patina my work. In short, this is the blackened and discoloured parts in the pendant photo. The process involves using chemicals to deliberately age (i.e. tarnish) the metal. This will happen over time anyway, but when applying the chemicals yourself, you can specify where and how tarnished. Different colours can also be achieved depending on the metal and the chemicals.

I could certainly understand the point about darkening the crevices to help the details stand out. However, I was initially quite reluctant to tarnish something on which I had worked so hard and then had to wait for in the mail. Eventually I decided to give it a go and I am very glad I did.

The first method I tried was a more natural approach using a hard-boiled egg. The internet will give many variations on the exact steps, but really it is a pretty simple process. NOTE: Don't expect to be able to completely remove or polish the patina off afterwards if you change your mind - it will come back a bit faster than normal once exposed to the sulphur. Think it through first.

- Clean your silver item thoroughly and have it at the ready.
- Hard boil an egg (or two for larger pieces), mash it up and place it in a seal-able bag or container. (Something that you don't intend on using for another purpose is probably a good idea.)
- Immediately put the silver item in with the warm egg. It will be easier to clean up afterwards if you can keep them from touching.
- Seal the bag or container as soon as you can because it is the gas from the egg that does the work. The more gas you can trap inside, the faster the process will go.
- The silver will then rapidly go through the oxidation process it would naturally go through anyway over time because of the sulphur. Left long enough (overnight should be plenty) it will go black, but it will go through a range of colours first if you want to remove it earlier than that.

Of course I tried it on a small, simple ring first and it worked just fine. However, when trying it on the pendant it worked, but it did not work evenly. I'm not sure as to whether this is to do with the amount of de-

# Printed Pirates

tails and surface variation or the size of the pendant, but I opted for Plan B.

Plan B in this case is known as Liver of Sulphur (LOS).

There are online options for purchasing this substance but it was available locally at a jewellery supply store. If you can find it at a local store, this is probably the easier option. You might just have to ask around at a few places.



Once again there are a number of variations on how to make use of Liver of Sulphur so I will just give a quick overview of what I did personally. I recommend that if you are interested in this process or other similar ones for different metals that you do some further research and see what will suit your needs. Gloves and very good ventilation are advised. It also smells quite heavily as you might imagine, so doing it outdoors is a very good idea if possible. Be sure to read the precautions that come with the chemical. (Note: All these precautions are why I tried the simple egg method first.)

- First I gently heated up the metal to 'remove' the previous patina. This step is only necessary because of the failed egg patina I did earlier. Fortunately the heat required to remove it is a lot less than the heat that would melt the metal. As mentioned though, it will tarnish faster than usual once exposed to the sulphur, so this isn't a complete reversal of the patina process. I used a small blowtorch for this, the handheld gas sort that has a range of uses. Obviously let the metal cool properly afterwards.
- Two containers (not to be used for anything other than this process afterwards) were then filled with water – a warm water one with a tiny (half a pea) sized amount of LOS and a room temperature one with some bicarbonate (baking) soda. A teaspoon or two of the soda is fine.
- Either lower the piece into the LOS using some string (definitely not your hands) or with gloves still on, paint the LOS solution on the piece with a brush. The brush may give you more control if you don't want to spend as much time polish-

ing afterwards. I simply submerged it to ensure an even coverage.

- The reaction should be fairly quick. If submerging the piece, remove at regular intervals to check what colours you are getting from the reaction. Once it has gone black, the colours aren't going to change any more, but you may wish to remove the piece earlier if you like one of the other colours.
- When happy with the colour, submerge the piece entirely in the bicarbonate soda mixture and then rinse the piece thoroughly in running water.
- From here you might be finished, but you will probably want to polish off some of the extra tarnish in certain areas. A simple polishing cloth should get the job done.

Naturally, different metals and other materials can have a wide range of post processing applied. Paints, varnishes, stains, burns and the like. Just remember that undo generally doesn't apply in the real world...

## CONCLUSION

All in all it was a very enjoyable experience. Taking the round trip from physical drawing to digital mesh back and then back to physical sculpture was great. Holding the finished product in my hands was very satisfying. The cheesecake was delicious.

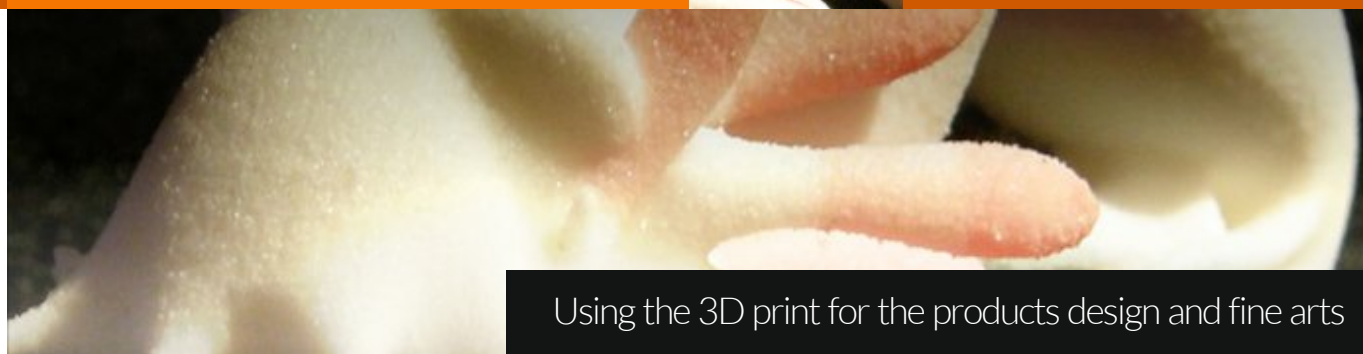
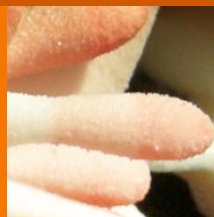
In all seriousness though - I'm excited not only by what I'll be able to print for future projects, but also by the increasing range of inspiring prints that are popping up now that the technology is continually becoming more accessible. Hopefully you've enjoyed this article and all the best for your 3D printed adventures! ■





# MAKING OF

Learning from experience



Using the 3D print for the products design and fine arts

## Shigeto Maeda

Contributing Author

We were looking forward to getting the technology to make our models not only an 'Image on the screen' but 'Tangible' for a long time. The 'future' is in our hands right now.

I've been using 3D printing for my artwork in the last two years. We could



use 3D print service through the internet easily, so today I think it's very common technology.

When I started my 'Generative Modeling Project', I had a plans to finally make them real objects. As a result of it, the project has been very interesting.

I don't have a 3D printer now, but I found and already ordered a resin type 3D printer from B9Creator. When you read this, the printer must be working hard.

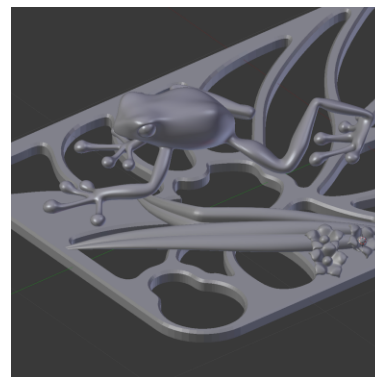
Usually, I use two 3D print services, 'Shapeways' and 'Inter-Culture'. As you know, with 'Shapeways' we could choose materials from many kinds and the cost



is reasonable, and it is speedy.

'Inter-Culture (a Japanese Company)' can make high precision models. I select which company to use depending on the cost/performance, materials etc needed for this project.

I have made many small figures (made with Blender of





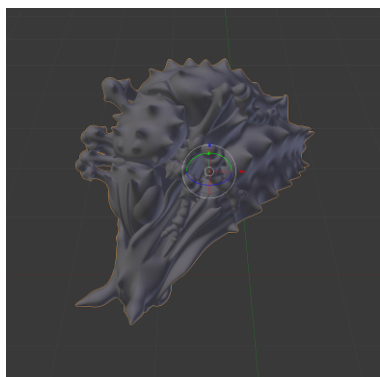
# Using the 3D print for the products design and fine arts



course), and some mock up models for products. I'm very pleased with their quality.

In some case, these printed models are saleable. For example, the jewels with silver materials, and iPhone Cases with plastics materials.

The things that I keep in my mind for ordering 3D print is the limit of the size and details. Defective results can happen if the model is too thin.



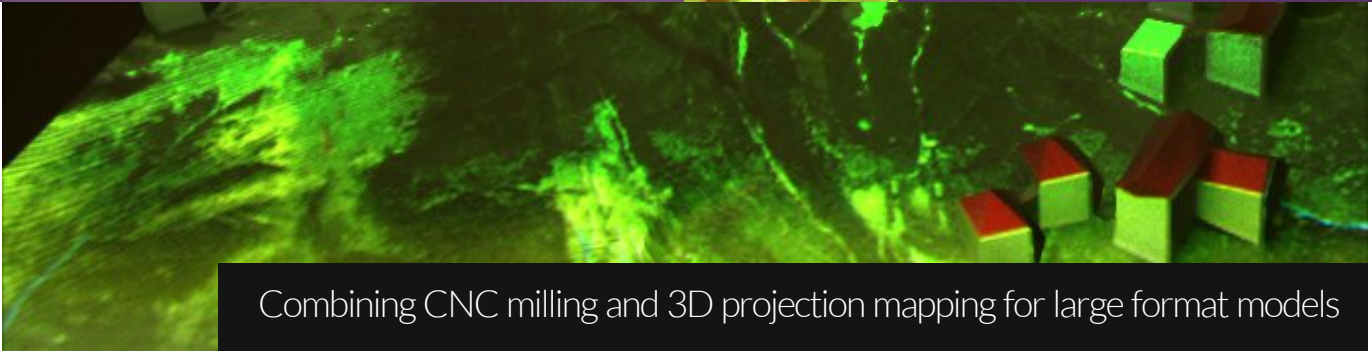
Some materials are very fragile. The models are damaged very easily during production and transporting.

Even so, the printed objects are so interesting. An imaginary life in the PC would be here, in my hands! That's really exciting for me ■



# BLENDING

Everyday blendering for all of us



Combining CNC milling and 3D projection mapping for large format models

**Joris Verbeken**  
**Virginie Peeters**

Contributing Author

## INTRODUCTION

The Landscape Architecture Research Team (School of Arts Faculty, University College Ghent, Belgium) is working on a research project called 'Ypres Salient'.

The landscape of World War One (1914-1918), near the town of Ypres, is the subject of a multidisciplinary research project. One of our research objectives concentrated on landscape visualization techniques. It was a local project partners' wish to have a model produced of an important historic landscape near the town of Ypres.

One important request was really challenging. The area of interest was special because the battles actually took place in different parts of the area. Could it be possible to somehow highlight these shifting battles with some sort of light projection, moving



Fig. 1 –Australian soldiers, passing along a duckboard track near Ypres, Belgium, 1917

over the model?

Our research team got interested in supporting the project partner, so we started a feasibility study on 3D printing. The quest actually resulted in the discovery of a system that we found interesting enough to share with the Blender artists community.

It should be mentioned that it is not our objective to criticize the valuable technique of 3D printing itself. It is only for the specific aspects for our project that we had to find for an alternative.

## 3D PRINTING?

The local project partner wanted to have an architectural model of a historic landscape of about 8 by 3.3 kilometers, on a 1:1350 scale. The model would eventually be 6 by 2.5 m in size. Some GIS data (Geographic Information System) about terrain, historical buildings, bunkers etc was available so it would have been a good idea to look for some sort of digital-mechanical system, instead of having it handmade.

Logically, the technique of 3D printing came forward. However, there were a few drawbacks. 3D printing proved to be rather expensive on this scale. The surface of the model needed to be at least a few millimeters thick, resulting in a considerably high amount of printing material. Several companies were contacted but all of their tenders were too expensive for the available budget.

Another difficulty was the fact that many 3D-printing machines are designed for smaller dimensions and

## Combining CNC milling and 3D projection mapping for large format models

not for models several meters in size. In our case, the complete model would have been composed of more than two hundred individual elements. As a consequence, this also implied a long production time.

One of the major drawbacks of the 3D printing process however was the fact that, once the model was printed, no further adjustments on textures or color was possible. Many digital artists know how challenging it can be to match screen colors with 2D printed media. For 3D-printing, this process can be much more difficult and the necessary trial and error tests would have been expensive and time-consuming.

This inevitable color matching problem frustrated us in the first place, but the ways we tried to deal with it stimulated our creativity and eventually led us to a solution.

### CNC MILLING...!

We already figured out that CNC milling (Computer Numerical Control) was less expensive and that larger dimensions were possible. Maybe, with a good test, we could have our model for a fair price, and let some artist color it by hand? Luckily, our colleagues from

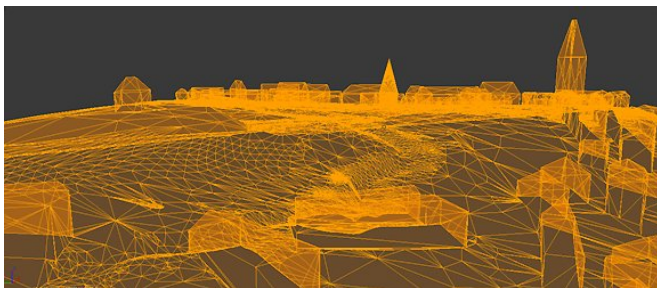


Fig. 2 -Wireframe of our model in Blender 3D

the Faculty of Applied Engineering Sciences (University College of Ghent) were enthusiastic about the project and wanted to produce a part of our model. So we started modeling... with Blender 3D!

Our research team had some experience in CAD, GIS and desktop publishing, but 3D modeling was fairly

new to us. But as weeks went by, it gradually came home to us that Blender 3D might be the ultimate tool to fulfill all the project partners' needs. Of course, most of our hunger for new knowledge was fed by the internet and there was one special description of a workshop, held by Benedikt Groß (Hochschule für Gestaltung in Offenbach, Germany) that gave a description of 3D matching. The website is completely in German, but the basic idea was clear to us. (2)

We concluded that, in theory, we had found a system that could work. We just had to do a test.

### ...WITH 3D PROJECTION MAPPING !

So we had a test model in a single color (white) that was milled by the Faculty of Applied Engineering Sciences (University College of Ghent), a standard laptop and a Hitachi ED-X10 3LCD Projector.



Fig.3 -CNC-milled test model. Dimensions: 25 cm by 25 cm

Could we find a way to project color and texture on this model? Of course, these machines are designed to project perpendicularly and on a flat surface. Our model wasn't flat at all, and we also wanted to place the projector in a skew position (e.g. 45 degrees, instead of the regular 90 degrees). This setting would make our test more rigorous, and, even more important, would indicate that several projectors could be used simultaneously, to highlight parts of our mesh that were not facing the average normal direction



# Combining CNC milling and 3D projection mapping for large format models

(e.g. walls or steep parts in the terrain).

The trick is actually simple. A camera in Blender 3D receives light from certain light sources that interact with the material of the virtual surface (our mesh) and captures this light, through a virtual lens, onto a virtual sensor. A virtual image is born. On the other hand, a projector works in the opposite direction. A physical emitter (the projector's lamp) radiates a virtual image through a physical lens onto a physical surface. In our case, the virtual surface (our mesh) and the physical surface (our CNC-milled model) are more or less the same. We only had to set up our virtual world identically to our physical world, which eventually succeeded!

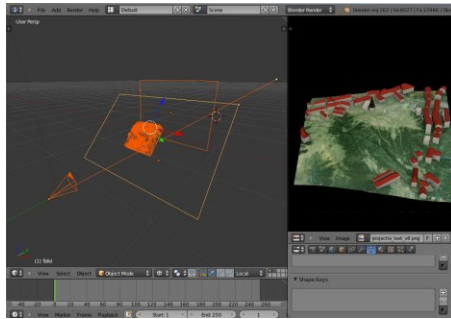


Fig. 4 -The setting of the model and the projector. Notice the angle of 45 degrees of the table on which the model is placed.

After a few hours of tinkering with rulers and protractors in the real world, and much more hours with Blender 3D in the virtual world, our first tests were promising. In fact the most difficult part was the vertical lens shift of this type of projector. Luckily, it is possible in Blender 3D to set up a vertical



Fig. 5 -TCamera and model setting in Blender 3D.

shift as well.

## THE PRELIMINARY RESULT

From an artists' point of view, our materials, textures, light settings, etc. need considerable improvements. After all, this is a basic test.

The photos included in this article also reveal that the mapping is not 100 percent correct. We are fully aware of this, but we can attribute this to the fact that our measurement instruments were not designed for precision work. Also, our 'test lab' is located in an historic building, where floors and walls are not always squared, making it difficult to measure.

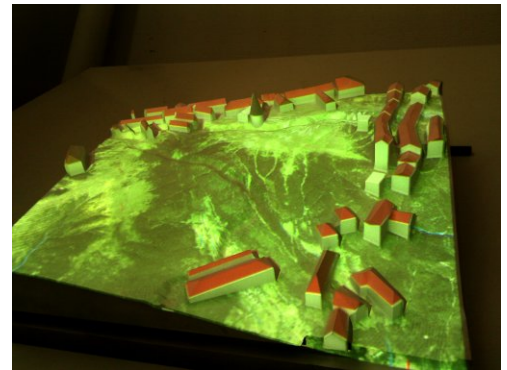


Fig. 6 -3D projection mapping, using a regular projector, a CNC milled model and Blender 3D.

Much work is being done at the moment to generate the complete mesh of 6 by 2.5 meters. We have also been working on the animation part, where different techniques were applied. We used keyframing on materials, textures and spot lights, and some modifiers (e.g. build) gave interesting results. However these results are difficult to show in this article. More tests are being done at the moment and further investigation is necessary, especially for a setting with multiple beamers. Nonetheless, we do hope that this description of our work in progress inspires other Blender artists with similar projects.

## ACKNOWLEDGEMENTS

The Ypres Salient research project is funded by the



## Combining CNC milling and 3D projection mapping for large format models

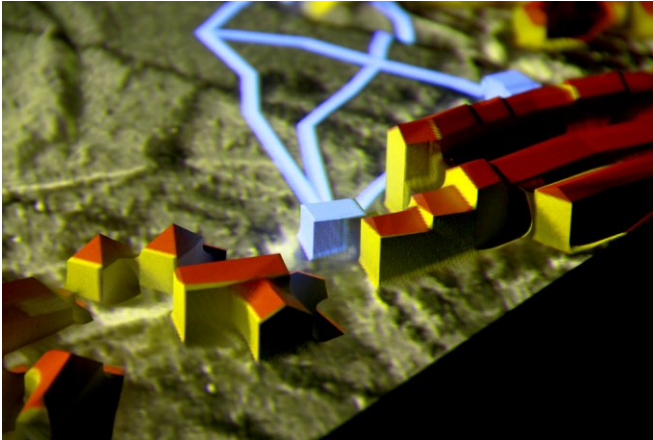


Fig. 7 – Detailed view of a part of the model. Notice the rich color possibilities. In this case, we highlighted the bunkers and emphasized their connection with lines. The mapping is not perfect, due to measurement errors.

University College of Ghent, Belgium. The research team consists of Steven Heyde, Ruben Joye, Harlind Libbrecht, Virginie Peeters and Joris Verbeken.

We are grateful for the tests, performed by Frank De Mets and his team of the Faculty of Applied Engineering Sciences (University College of Ghent, Belgium).

Many thanks to Bram De Vries for our first steps in Blender 3D and for the valuable advice on 3D printing and projection.

### REFERENCES:

- (1) Frank Hurley, 29 oktober 1917, Australian War Museum, E01220 (Image copyright: Copyright expired - public domain / <http://cas.awm.gov.au/photo-graph/E01220>)
- (2) Description of a 5 days workshop in Schwäbisch Gmünd on 3D matching: [http://ig.hfg-gmuend.de/Members/benedikt\\_gross/lehre/100-Jahre-workshop](http://ig.hfg-gmuend.de/Members/benedikt_gross/lehre/100-Jahre-workshop), consulted on Oktober 5, 2012

### Author contact:

Joris Verbeken – GIS lecturer

Royal Academy of Fine Arts & Royal Conservatory /  
Vakgroep Architecturale Vormgeving  
University College of Ghent,  
Jozef Kluyskensstraat 2  
9000 Gent  
België

[joris.verbeken@hogent.be](mailto:joris.verbeken@hogent.be) ■

# BLENDING

Everyday blending for all of us



Makers Factory

## Chris Yonge

Contributing Author

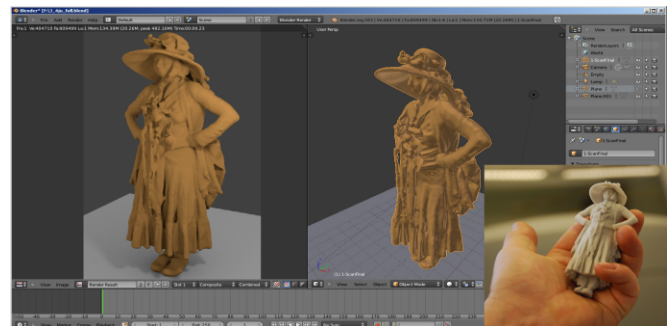
The last few years have seen a remarkable change in the ability to create and produce computer generated 3D forms. Not only has open source software such as Blender become far more usable and reliable but commercial companies have jumped into the mix with high quality free programs such as Google's SketchUp, Pixologic's Sculpttrix, and Autodesk's 123D. On the hardware side, 3D extrusion printers from MakerBot and UP are approaching the sub-\$1000 mark, while online services like Shapeways and Ponoko provide affordable 3D printing in plastics, ceramics, metals, and glass.

MakersFactory, based in Santa Cruz, California, is a professional services/education company which specializes in the use of open source software with in-house and online 3D printing. The majority of our clients are creative professionals who need fast, accurate visualization and prototyping. Blender, like other open source



programs such as Inkscape, Processing, and Gimp, is a vital part of this work process.

Let's look at what MakersFactory has in terms of hardware. Apart from an Epilog laser cutter/engraver, a NextEngine 3D laser scanner, and a Roland vinyl cutter, we have six 3D printers. The – literally – eight hundred pound gorilla in the room is a top of the line Z Corporation 650 color powder printer.



This machine produces four color three dimensional models up to 15" by 10" by 8" high. We also have an older Z Corporation model, a 310, which has been reconfigured to use cement powder in its 8" a side cubical build chamber. That only has one color – cement – but makes up for that with its affordability.

Powder printers are simple in concept though complex in reality. A layer of powder the thickness of a sheet of paper is spread over a steel build plate. A set of five inkjet heads then go back and forth across it. From four of them colored ink – cyan, magenta, yellow, and black – is printed as in any other inkjet printer. But the fifth print head spreads a binder, like a

# Makers Factory

thin glue, and this solidifies the layer of powder into a cross section of the 3D model that is being made. Then the build plate drops down a fraction of an inch within its surrounding walls, another layer of powder is spread over the top of the previous one, and the process begins again for the next cross section.



Powder printers take an hour for each inch of height, but accept items that are stacked and nested so that the build chamber can include dozens of objects. After printing is complete the items are surrounded and supported by loose powder. Using a vacuum hose, brushes, and a lot of care, they are dug out, and unused powder is recycled into the machine. The prints are removed and de-powdered with a compressed air jet in a closed chamber. At this stage they resemble unfired clay, and are fragile, dusty, and with faint color. After they have been de-powdered a strengthening agent, either cyanoacrylate (superglue) or wood hardener, is applied to the surfaces. This strengthens the prints and brings out the full brilliance of the colors. A quick sanding in a bead blaster, a light spray with polyurethane varnish, and they're ready for prime time.

As well as powder printers, which produce items that are colorful and complex but somewhat fragile, we have four plastic extrusion printers. These devices can be likened to miniature hot glue guns, as they produce a thread of molten plastic from their nozzles that is precisely laid down in layers to build objects up to eight inches on a side. The objects can only be one color, but that color can range from black, white, and

translucent through vibrant yellows and blues to more muted grays and browns. The reels of filament are generally engineering grade ABS plastic though some printers can also handle the similar biodegradable, milk-derived PLA (Polylactic acid) material. Extrusion prints are light and tough, well suited for engineering prototypes and models that will see hard use.

MakersFactory uses Blender in several ways. First, we have regular Friday 3D scanning sessions for people who want a model of themselves made. This is done using a Kinect device with open source software, and produces large .OBJ files which need cleaning up in Netfabb and then rendering in Blender. Sometimes the 3D print file is also made from Blender, using an .STL file to export the form.

Organic forms for monochrome 3D printing are also generally made in Blender, and exported as standard .STL or .PLY files for direct opening by the Z Corporation printer driver Zprint. For mapped graphics, however, we have best success exporting textured .3DS files from Blender, opening them in Rhinoceros (a useful file translator as well as NURB modeler), and then saving out in the proprietary .ZPR format.

We teach Blender to children and adults; our youngest students are nine years old and our oldest ... well, we've hesitated to ask. Probably late sixties. But everyone – I believe – enjoyed the classes, learned about 3D modeling and animation, and has been given the ability to create in a digital environment, all due to Blender.

Finally, I also teach Blender to students at the University of California, Santa Cruz. The classes at MakersFactory are fairly simple, focusing mainly on the creation and animation of a simple box modeled character, but my course at UCSC lasts a full quarter – ten weeks – with two lectures and two labs per week. It covers most of the basics required to become productive and confident in Blender. It is also highly

# Makers Factory



popular, never failing to fill its 175 places twice a year with one or two dozen auditing students in addition. Most are game design majors, though there is also a significant presence from astrophysics, film and digital media, marine biology, and the mathematical sciences – evidence of the wide demand for 3D modeling and visualization skills. And, though it's not an intended consequence of the course, several students have changed their career choice to professional animation as a result.

The depth, richness, configurability, and power of Blender makes it an ideal tool for production and education. MakersFactory, the School of Engineering at UCSC, our students and clients, and ourselves would be far poorer intellectually and creatively without it. Congratulations to the Blender team!

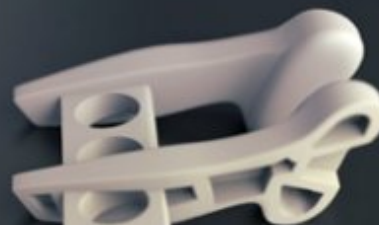
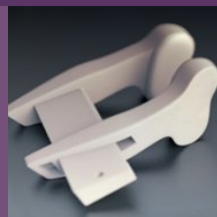
[chris@makersfactory.com](mailto:chris@makersfactory.com)

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# BLENDING

Everyday blendering for all of us



3D printing with Blender and Ponoko

## Richard Borrett

Contributing Author

There's an increasing range of making options available to Blender users, from full fledged 3D printing services like Ponoko, Shapeways & iMaterialize, to DIY options like Makerbot and RepRap. These are all a fantastic opportunity to take something that was once constrained within the computer, and turn it into something tangible that people can hold, feel and interact with.

As well as printing several of my own personal projects, I get to see nearly every single design coming through our system. This has given me a pretty unique viewpoint, where I get to see lots of stuff going right, and lots of stuff going wrong! With that in mind, I've taken what I think are the most important things to know, and compiled a list of things you should know about 3D printing

- Remember to design for the real world, not Blender. It's super easy to forget about stuff like material properties and gravity when you're modelling something, or be so super zoomed in creating details which are going to be so small that in reality you won't be able to see them.
- Know your materials. 3D materials have some unique properties that you need to consider when you're designing your object such as the crumbly "green state" of stainless steel, or the extrusion process of FDM. In particular, make sure you've got your wall thickness requirements met.

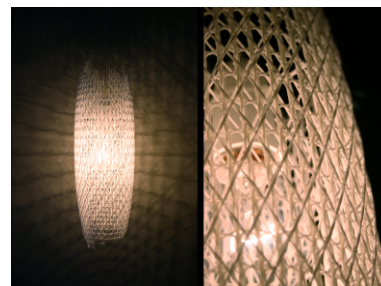
- Design for 3D printing. 3D printing is great for intricate objects and low volume designs. Embrace this! There's no penalty for how detailed your objects are, so go nuts with it. Remember that most 3D printing services charge you by volume NOT complexity, detail or size. Reduce the volume, reduce your cost! So many designs are already much stronger than they need to be, and can be made much cheaper by hollowing out your design, or removing volume where it's not needed. Remember that there's no cost penalty for detail, so use this!

- Check your units! Pretty easy one to miss, but always check the units of your file before you send it to the printer. 5 inches is pretty disappointing when it turns out to be 5mm! If you're working with an STL file, 1 Blender unit = 1 file unit - you'll specify this when you upload your file to the making service.

- Non-manifold mesh errors. Blender has a great shortcut to isolate non-manifold vertices: CTRL+ALT+M selects all non-manifold vertices. There are 2

common culprits: Vertices with 0 or 1 edge attached, and edges with anything greater or less than 2 faces. It's important that your design doesn't have any internal walls, as these confuse the 3D printer as to what is "inside" and what is "outside" your design, and it won't be able to be printed.

- Netfabb is a great free tool to measure your STL file and check the volume before you upload it to your making service. It's an easy way to make sure you're meeting the wall thickness requirements of your material, as well as spot any nasty mesh errors you



# 3D printing with Blender and Ponoko

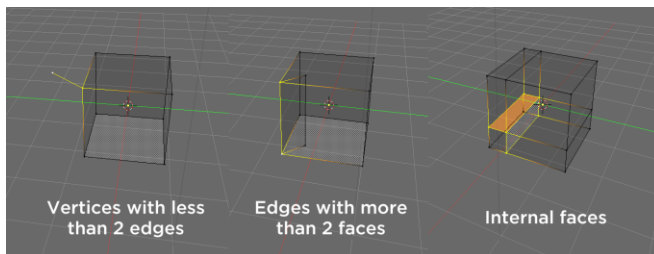
might have missed in Blender. Particularly useful is the “Cut” feature which lets you easily see a cross section through your file.



- **Prototype!** Mistakes are expensive. We can make our best guesses as to how a given 3D design will come out, but we'll never know 100% until we print it. Small prototypes allow you to experiment with the material & design before committing to a full-size print - especially important if you have specific material requirements, like flexibility, strength or surface finish.

Prototype. Seriously.

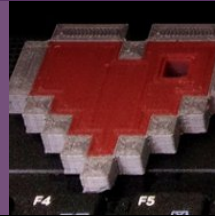
- Have a go! It can be a little scary at first, but there is a wealth of expertise out there.



**Tip for complex geometry:** Use Ctrl-Alt-Shift-M to select Non-manifold vertices. Expand this selection a couple of times with Ctrl-+. Invert the selection with Ctrl-I and hide these vertices with H. Select the non-manifold vertices again with Ctrl-Alt-Shift-M ■

# BLENDING

Everyday blendering for all of us



100 hours of print time, and what I've learned...

## Metalnat Hayes

Contributing Author

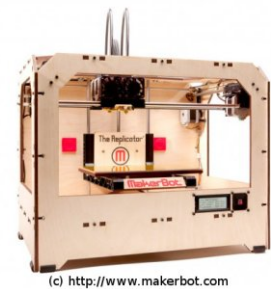
Using the **Makerbot Replicator**, the process is as follows:

- Make model in blender
- Export .stl file
- Open ReplicatorG
- Open the previously saved .stl file
- Press "Scale" button
- Press the "inches -> mm"
- Press the "Move" button
- Press the "put on platform" button
- Press the "center" button
- Then on the top I select the 4th button in green "Model to GCode"
- Select the default profile for the machine, and then choose the options you want for this print
- Then press the "Generate GCode" button on bottom.
- \*Then I edit GCode (only if I'm printing with PLA, to change the heating build platform from 110 to 50)
- Then select "Build to file to use with SD card" and save the .s3g file to SD card
- Insert SD card to makerbot and print from the SD card.

Everything here has a purpose and I won't be able to cover every reason. If you have any questions, my e-mail is [metalnat@penguinpouch.com](mailto:metalnat@penguinpouch.com).

## EXPERIENCE

The most common issues I've run into involve the leveling of the building platform, overhangs, flipped normals, hidden faces inside the mesh, and converting model size to real world needs. So let's hit on what was done to address each of the issues on this list.



(c) <http://www.makerbot.com>

For leveling the build platform, use the in-system leveling option at first. I've found it to be far better to level during a print of something with a wide base (advanced). You are aiming for a flat line of plastic being pushed into the build platform, not a rounded tube being lightly placed on the surface. Also when leveling this way, do not use "raft/support."

The rule on overhangs is to be aware of the angle of change for an overhang not to exceed a 45 degree angle. There is a little more that you can push with, but when extending too far, you will have plastic droop off of the side of the print, and then "maybe" catch a little bit on the next layer of some of the dropped section. Things get messy fast. There are ways to print overhangs with a lot less worry and that is using "raft/support." that is an option you can select when you are generating GCode. This will create a thin line of plastic that will build up with the model so that it can catch the bottom of overhangs. That "scruff" is kinda fun to pull off.



# 100 hours of print time, and what I've learned...

When dealing with flipped normals and hidden faces there are some things you must consider. Many people say the best way to deal with this is to import the .stl of the model into a yet another program and do a "clean" or "repair." I personally have opted to be stubborn and figure out what I'm doing wrong in the first place! To self-diagnose, first identify the faces that are "inside" your mesh but are not intentional.

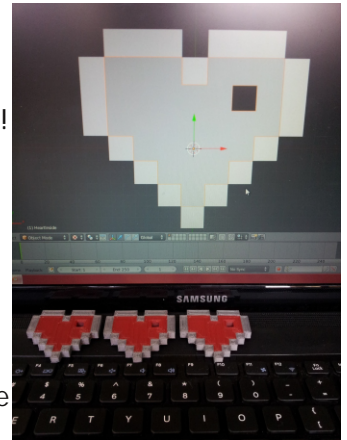
The best example of this issue happening is when you extrude 4 vertices on one side of a cube. When you do this you are given 4 new vertices, and 5 new faces. The model on the outside looks fine and you just made the square a rectangle. But what was left behind was a face between those 4 vertices. At no point did we tell blender to remove that face, so it remained to throw things off later. Be aware of what you are leaving behind when extruding. Also consider a "remove all doubles" just to be safe.

In dealing with normals it is important to make sure that normals are facing outward, otherwise the print will attempt to print up to where the normals face. That may sound confusing but if an object has three faces on one side and one face happens to be flipped, then that flipped face will be bypassed because there is no printable area behind where the normal is facing.

Most of the time that I have run into this problem is when I was joining meshes with boolean unions. At the intersection of two meshes you may have faces flipped randomly. I'm sure there is a reason to this madness, but I just assume the role of inspector after each union.

Now you may have the need to make something "functional" for real world. Or something really awesome, but it has to fill a certain space. The way I personally have addressed this, after lots of tests, is to assume the default cube is a 2' x 2' x 2' cube. So, if you press "s" for size and type .5, you now have a one inch cube. If you remember my list earlier, in ReplicatorG i select "scale" and then "inches -> mm." this allows me

to work flawlessly with default blender units and have a mesh in 3D view that isn't unbearably huge! So modeling sections are easy enough now, as long as you are comfortable typing in your measurements in inches. So if I want to move a vertex 2.75 inches, I just select the vertex, press the "g" button, then press "x", "y", or "z" depending on the axis I want to move on and then immediately type "2.75". That principle is carried throughout the model. If you are modeling around a real world object (like an LED) then make a model with the dimensions using this method, and then artistically make the model fit around the modeled template of the real world object.



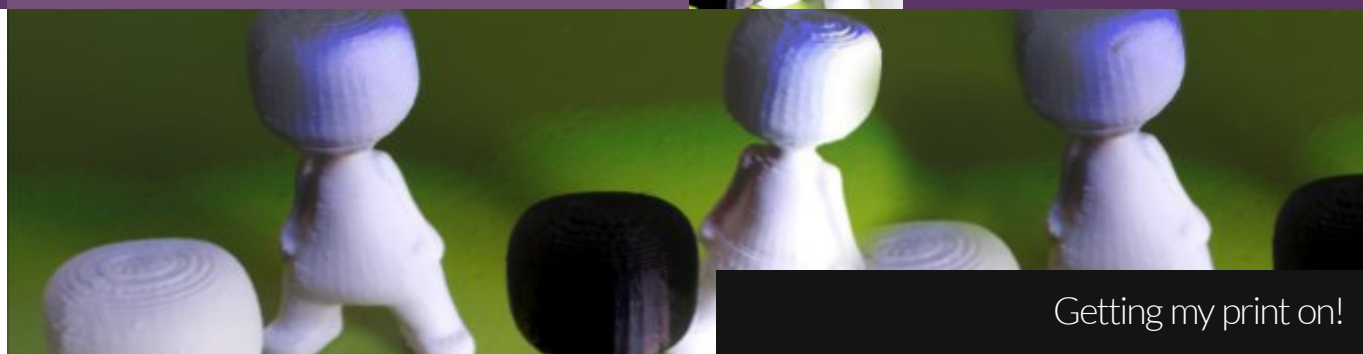
The last thing I've had the privilege of working on was dual extrusion prints. And I've included a file to be used. When you create a dual color print, at least with ReplicatorG, you will find that you have to create an .stl file for each color, and when being printed each color will have no awareness of each other. It is possible to have the printer print twice in the same 3D space. Sounds cool I know, but can cause the printer to get jammed up.

And it is a pain to clean at times. You may also notice particles of each color found on the outside edges due to the nature of plastic melting and expanding inside the print heads "nozzle." One way to address this is to enable a profile to build a "skirt" around the model to catch all the loose particles of plastic. This is an advanced setting to handle, but alternatively, it is easy to scrape off most of the loose plastic.

My best advice: try things, take chances, and have fun! ■

# BLENDING

Everyday blendering for all of us



Getting my print on!

## Dolf Veenliet

Contributing Author

A few years ago I received an e-mail from the people at Shapeways asking whether they could use a model of mine for their promotion. Back then, hardly anyone had heard of this brand spanking new phenomenon called 3D printing. The model in question was one that I had created for the Blender Conference Suzanne Awards in 2007. Its name is Petunia, after a flower and as a joke on the Blender Institute's projects all being named after fruit.

Shapeways was kind enough to get me a copy of the 3D print, and they had someone make quite a gorgeous photo as well! This photo then went on to get published all over the place.

From newspapers in New York to the Brisbane Times! I'd never gotten as much attention for a piece of my work as I did then. And all because I did a small model for the Blender Conference and shared it under a

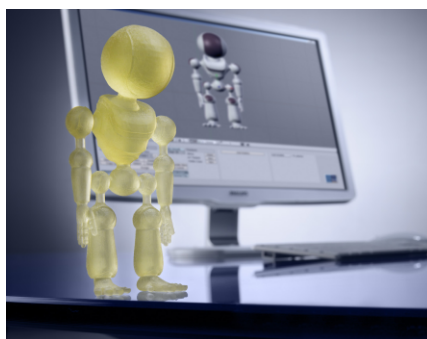


Fig. 1 –Petunia as a 3D print courtesy of <http://www.shapeways.com>

creative commons license.

## GETTING THE BUG TO BITE ME

If you haven't yet... I have to warn you. There's little that prepares you for the feeling of holding one of your 3D models in your hands for the first time. It's somewhat magical, and made me hungry for more. You see... I was trained as a traditional artist, and only got into computers after I got my degree in monumental art. This latest development felt like a completely natural return to my roots without abandoning my new found tool-set. Great!



Fig. 2 –me holding one of my entoforms <http://www.entoforms.com>

## THE BIG MISCONCEPTION (OR ONE OF EM AT LEAST)

There seems to be the general consensus that 3D printing means... well... that anyone can make anything now! If you have a great product idea, you can get it into the marketplace yourself by making it available for print. I don't think that's true.

Pretty much every product you can come up with needs to be tested. Even if it's just a statuette you need to print out a test to make sure it can be printed, and see what its really like. I recently had a great idea

# Getting my print on!

(at least I think so) for a commercial product, had a test print made... and only then found out I had to make it twice the size to make it function, and that would have put it in completely the wrong price range.

So you see, you still need to have some money for testing.

## BUT I CAN BLEND

Where design was mostly 2D in the past, one of the biggest benefits for us Blenderheads is that since 3D printers are everywhere, people need more and more 3D design as well. And yes they are everywhere indeed.

A major Dutch department store just started selling them for 1000 Euro-ish. That means your mom can buy a 3D printer and print herself... well absolutely nothing until you teach her to Blend (that's a job), or she gets you to make her a design (that's another job). And if your mom can, so can everyone else's mom! And they all need our help. Of course by mom I mean, anyone, or the less computer literate amongst us, except for your mom, who I'm sure is a whizz on the keyboard!

Now that everyone can get a 3D printer, they need us to help them make stuff, or make tools for them to make stuff!

## SO MUCH TO DO NOW THAT IT'S BEEN DONE

For a while everything that you 3D printed was cool just because it was 3D printed. And as long as you were the first to 3D print it, it was pretty certain you could get some attention.

You might even make a buck. That was great, but it made it all very

gimmicky as well. I think/hope/believe we are coming to a point soon where no one cares about 3D printing any more. It'll be more of a "Hey what is that?"... "Oh my new 3D printed toy"... "Duh of course it's 3D printed. I want to know where you got that great design from?". It's about time we stop caring so much about technique and start thinking more about design/concept/coolness again.

## AND TOMORROW I WANT A...

Maybe the trickiest thing about 3D printing is that it's a bit like a tablet computer. You don't really know what it's good for until you own one (or have used one for a bit). For me personally, it's exactly the tool I want to use right now, and I never would have known hadn't I been using Blender for the decade before 3D printing became a thing! Now let's see how we can take all this cool stuff we can make with Blender, and make it real! Because in the end, for me, that's what it is about ■



Fig. 3 –one of my commercial ideas, the variable cross <http://cross.shapewright.com>



Fig. 4 –my makerbot before I unwrapped it

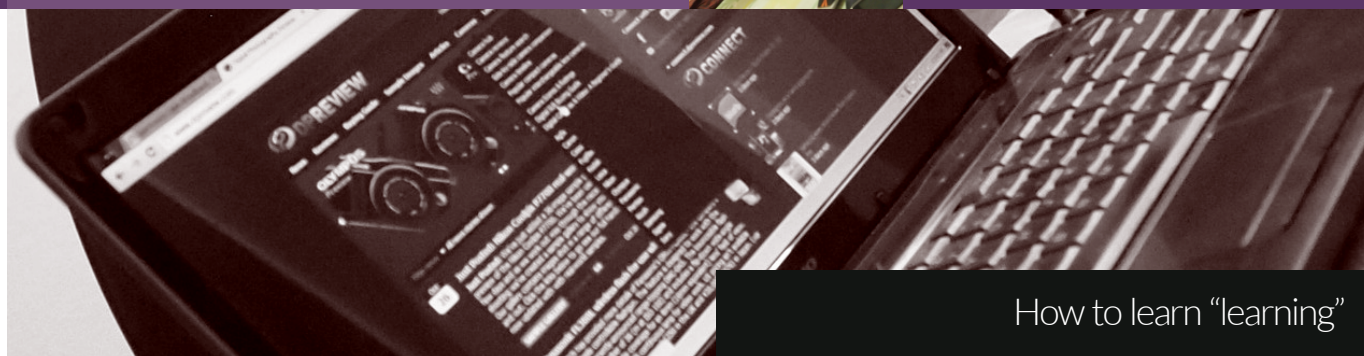
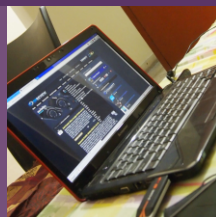


Fig. 5 –4 versions of blu... a 3D printable model available at <http://www.thingiverse.com/thing:31767>



# BLENDING

Everyday blendering for all of us



## Hakki Rıza Küçük

Contributing Author

**T**o learn is the most important thing around the Universe, and we are living in an information age. This is the easiest age “to learn” anything. If you would like to learn something, just click and ask Google. I can assure you that even learning languages is completely possible with Internet resources.

Were you ever curious about how people learned Blender 1.x? There were very few tutorials, websites, articles or teachers. Maybe you can say that they did not know blender 1.x, they learnt Blender about 2.4x.

Nope.

Trust me, I talked with them, they knew both blender 1.x and blender 2.4x.

### HOW TO LEARN “LEARNING”- DESTROY TABOOS IN YOUR MIND!

I want to talk about my opinions topic by topic. The first one is “Taboos” in our minds. In the past, if someone wanted to learn Blender, they must “try”, because there were no tutorials available.

In the old versions of Blender, there were lots of bugs and a lot of features that are not present in the current version of Blender. But when I saw a car render with Blender Internal and in Blender 2.49, I realised that “ the problem is not in Blender, the

problem is in our minds....”

And you know, if professionals are better than beginners, the reason for that is not that “professionals are in this job for longer time than us”. Don’t kid yourself. They are better than us, because they are creating, and always doing new things.

So, what we are doing?

We are watching tutorials and making simple models.... I know just a few people who are working on real projects. And they are going to be a professional!!!

You know, I want to mention a taboo which is in our minds when we start to watch any tutorial: “I am afraid to try. However, the guy is teaching, they do first, then I will....”

I am sure that you don’t agree me when you read this. “no I am saying like this,” Because of this, what I consider to be the worst taboo, we are afraid to try, and then because of this taboo, you decide on something, and think that there is only one way to do the model.

“Hey man did you hear? There were only a few ways to model a soccer ball”

“Yeah, he taught one of them”

“ Hmm... So we have only one way to do it....”

“Yeah! So let’s do it.”

# How to learn “learning”

Then every single Blender user only knows one way to do a soccer ball because they have a soccer ball and they don't have to learn another way to do it.

Don't be afraid to try. Use a reference photo from the first moments of tutorials that are showing the result and then try to make it without watching the tutorial. If you can't figure something out, watch the tutorial, then stop it, and continue to try again. Then you will realize that “Hey, I know Blender!” :-). I know if you do this, it will take lot of time for every tutorial, but it is worth it.

Try, it is not important that Blender crashed, we can start it again, but we can't go back to the past and can't live the same time again.

I am not saying that tutorials do not help us. We have a tutorial ocean now, and unless we use it correctly, we will drown in that ocean.

“Don't be afraid to try.”

## HOW TO LEARN “LEARNING”- CREATE AN IMPULSE TO DO BEST

“He is a professional. I can't compete with him. It is an unnecessary effort to compete with him.” Don't think like that, try to beat him.

If we do have not a deadline or someone who is better than us or a work that we want to recreate, we can't improve ourselves. We have to have an attitude that will give us the impulse to keep getting better.

A lot of us are learning Blender for a hobby which makes it harder to Blender than if we were doing it for a job. We must choose a way to get better. There must be an impulse in our mind to push us to keep learning. This is really easy to put it in our mind, because it is still there from when we were babies who are curious about everything.

So that is all for this topic?

Nope, now I will talk about the important points to make it awake in our minds.

Are you a beginner and you can just make a few things in Blender? This is for you! Check previous Blender ART Magazine's gallery chapters and choose a render that you find really impressive. Then say to yourself: “I will do this in the future”. Put the render somewhere in your computer. After a few months, you will find the render again it won't look as impressive. Then try to make it again. If you can't, you will realize that the impulse will start up again and you will want to learn more. This is the best impulse I think. For example, when I was beginner in Blender, a 2D printer with an electronic notepad, was too impressive for me. I am still trying to make it again ...

## HOW TO LEARN “LEARNING”- DIG YOUR WAY WITH YOUR FINGERS

Actually, for this topic I met with Gottfried Hofmann. He is the founder of BlenderDiplom and his job is all about physical simulations. He started to use Blender in 2009 and at the time, it was hard to learn physical simulations.

When I asked “So, how did you learn about smoke and fire simulation so well?”, he said “I had to dig my way through with my hands!”.

It was impressive; he was learning Blender by himself, asking questions, trying without being afraid, searching and things like that... Eventually, he became one of the best smoke simulation teachers in the Blender community.

But, Hofmann knew one more thing: “where I am going to?”. This is a good question. For example think that you are climbing Mount Everest. Finally, you reach your goal, you turn around to see how far you climbed and ohh.. COME ON! Everest is on the other side! Unfortunately... you climbed to the wrong mountain... but Hofmann knew this when he started. Keep this little tip in your mind, and know where you

# How to learn “learning”

want to go.

So you might be asking: “Why do I have to dig my way with my fingers? Why can’t I ask other people?” What if you fall down from the middle of the mountain, there won’t be people who will help you. You won’t fall down if you do the same as Hofmann, but if you do fall down, it will be very easy to climb to the same mountain again...

So let’s talk about how? We are not climbing to a mountain, we are learning Blender 3D! The first thing that you have to do certainly, is SEARCHING. After Blender is first released, 14 years passed and now there are lots of forums everywhere, lot of tutorials websites and thousands of topics and questions.

Don’t go onto Facebook and write “how to add an ocean simulation?”. You probably saw some Blender features which are taking your mind away and you want to learn how to make an ocean simulation. However, this is the wrong way to learn, you can search for the same on Google and learn it from tutorials and articles. To ask people all the time is like taking help from the other climbers... What if you fell down?

But if you can’t get any results from your searches, then asking people is okay. For example, Hofmann was one of the people who had to ask. Because there were hardly any tutorials about what he wanted to do. He is one of the people who knows how to learn. They were lucky because they have to dig their way with their fingers... I hope after this article you will learn how to learn, as well.

## HOW TO LEARN “LEARNING”- ASK

Just ask. Ask until they are not answering anymore. To ask is one of the most important learning styles. Think about when your teacher is talking about math and you can’t understand something. Without asking, will your teacher explain the issue again?

Did you ever watch a 3D movie or a showreel or a test animation?

And did you ever say that “how did this guy do this?”.

Do you know why Andrew Price opened a page called “winners hall of fame”?

Because they want you ask something of them. Yes, actually, they really want that. Select any good work from any artist, find the contact information and try to ask something. You will see, they will get back to you if they are not busy :-).

My brother who is advanced with 2D, is always asking questions of people who are impressive to him. And he has a philosophy that you must ask until the person doesn’t answer anymore.

Be a little bit cheeky, ask until they are not answering anymore!

And I want to add a little note, don’t confuse searching and asking methods.

I am talking about asking, but not always in forums. I am just suggesting to ask special people. And do not forget searching.

So guys I hope you “learnt” something from here. And I don’t think so but I hope you also enjoyed it :-).

See you next time! ■



# BLENDING

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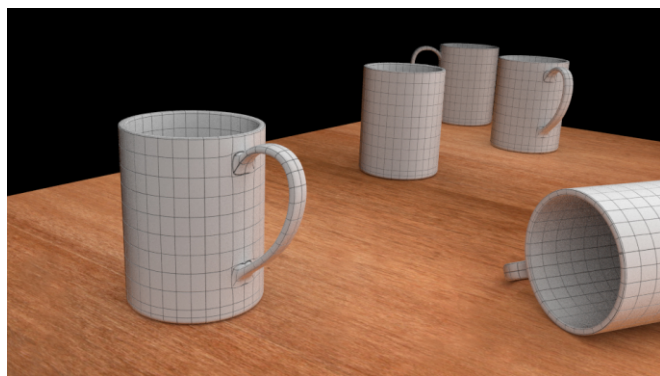
3D Printing a Mug

## Krzysztof Bozalek

Contributing Author

After making the mug out of the clay you will have the grooves to fill in the paint, that creates the mesh pattern ■

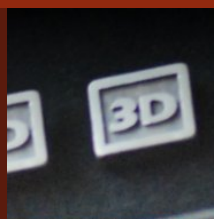
Since I got into 3D graphics, I was looking for some gadget to keep me closer to the subject. After playing with the web searcher I found the mug render, painted in the mash pattern. There were a couple of mug mesh renders but that was all. I figured it out. It will be necessary to start a new project to decorate the mug that way. The best way to do this is to print the model on the 3D printer, considering the lines are going to be painted in the grooves on the surface.



- The first thing I have done is model the mug I would like to have, keeping my eye on the typology that I would like to see on the surface.
- Then I unwrap the model and export the layout to Photoshop.
- Then I use the layout as a texture of the model.
- Use it on the display modifier to make grooves on the mug.

# BLENDING

Everyday blendeing for all of us



How to become a successful Blender Shapeways designer

## dreamsgate

Blendermom extraordinaire

For many of us, there is something of a mystery concerning the whole topic of 3D printing. 3D printing, in and of itself sounds like something straight out of science fiction. And yet there are those who have already mastered not only the art of designing for 3D print, but are actually selling their designs as well.

So just how do you get from a cool Blender model to a 3D printed object worthy of being sold? To answer that question, we rounded up a couple of successful designers that routinely use Blender to create awesome models that they then print and sell through Shapeways.

One aspect that seems to be important is the ability to find and



market your own niche. So first we take a look at Mark Bloomfield and his wonderful [Electrobloom](#) creations. Mark has launched a fun and creative line of 3D printed jewelry that is not only customizable but can be worn and put together in an endless variety of creative ways. Mark, a trained jewelry designer has come up with an amazing concept that allows his customers to choose various components and materials to make their own unique pieces that can be worn as rings, bracelets and necklaces.

## What was your inspiration for Electrobloom?

I came up with the name Electrobloom some years ago before I knew what I was going to do with it! I wanted a name that included my name but also implied a collision between the old and the new, I like strong contrasts so Electrobloom had the right ring to it. After living with the name for a few years I decided that I wanted to do something hi-tech with flowers, so I then started to develop a jewellery collection using floral motifs that would be made using 3D printing processes.



## Your jewelry line is modular and customizable, what prompted you to chose modular designs over say fixed designs?

It was the sheer amount of diversity in the natural world that led me to develop a customisable collection, even plants that appear the same are very different when you look at them closely and a customisable collection allows for these differences. Also, the 3D printing process removes many of the constraints that traditional forms of manufacture enforce. The idea behind a customisable system is that



# How to become a successful Blender Shapeways designer

nothing is fixed and can evolve over time. As a designer the investment you make in a fixed design can be difficult to recover but I'm finding that each new item I design both expands and changes the collection in ways I couldn't have imagined at the beginning. It's also beneficial to the customers who buy the jewellery because they can swap charms over and add new designs to their own collection without having to discard all the items they bought in the past. I want to involve the customer in the creative process, everything works together and you can have some fun with it, making your own collection!

## How often do you create new designs or pieces?

I'm always thinking of new ideas, it never seems to stop! I'll do lots of sketch modelling to see how new designs will look and then get into the detail to make sure they will work. That's the beauty of using a tool like Blender, I can quickly rough out an idea to get the look right and then refine it. I use Blender's modifiers a lot to enhance simple meshes that are easy to manipulate. It also means that I can go back and re-use different set-ups which can really speed up the development process.

I like to make sure that the designs actually work once they've been 3D printed before offering them for sale, but waiting a couple of weeks for new designs to come through can be both frustrating and exciting! I'll work on new ideas while waiting for 3D prints to arrive and then refine those designs if needed once I've seen the physical sample.

## Do you plan to expand your line to more than "bloom" type creations or have you found your niche?

I'll always focus on plant motifs and be inspired by natural forms but I'm also interested in how they change over time. I've worked in the fashion industry where seasonal change is the main reason for introducing new collections and I still want to use that process. But rather than working 2 years ahead as with traditional manufacturing, I'm able to be more re-

sponsive and develop new styles in season. I introduced new charms this autumn and have started to develop new styles for winter. Obviously there are not many flowers in bloom during winter so I have to look to other forms of inspiration such as leaves, twigs and decay. I've also designed charms that move or change shape which adds another level of engagement and wouldn't normally be done using traditional forms of manufacture due to the expense, but 3D printing makes these impossibilities possible!

## Are there any difficulties or obstacles to overcome during the design phase, either in Blender or with Shapeways that you had to solve to obtain good printed results?

Sure, as with anything you design for manufacture it's important to consider that it can be made and that it's going to work! Shapeways has a good resource that explains each of the 3D printing processes they offer.

It's important to remember that the term 3D Printing covers a wide range of different processes and materials, each with their own set of characteristics and tolerances. I'd always pick the most appropriate material for the design or if I wanted to use a particular material then I'd take into consideration the material characteristics and the production process to ensure the design will work.

As I mentioned I have designed and made items that move. This has been particularly challenging as the 3D printing process I use requires a 0.4mm tolerance to ensure the parts do not fuse together. But as I'm using a Laser Sintering process which fuses a powder with a laser to make solid objects, you also need to be sure that excess powder can be removed to allow the parts to articulate.

Sometimes this works first time but I have had to make tiny adjustments to some models in Blender to get them to work. And although 0.4mm doesn't sound like much, when you're working at a jewellery scale it's surprising how easy it is to run out of space!



# How to become a successful Blender Shapeways designer

## How would you describe your experience using Shapeways?

In general it's been really good, I love being able to upload new models at midnight and get an instant price, it's a really convenient service. And if there have been problems, then the customer service team are on the case and resolve issues quickly. I feel that there will continue to be issues as this is still a relatively new way to make things and each new design presents its own set of problems. An active community also helps, there's always someone on the Shapeways forums that can answer questions or point you in the right direction, all you have to do is ask!

## How have you marketed your creations? What has been the most successful marketing you have done?

I am a bit of a Twitter addict and have used it to test different marketing ideas but I mostly use it to let people know what I'm up to and to share news. I've yet to finalise a full marketing plan, but I'm working on it! Just as 3D printing is a different way of making things which carries benefits such as 'made on demand, made to order, customisable and potentially made locally', I also want to come up with different ways of marketing my designs.

I've been experimenting with Augmented Reality and linking AR virtual objects found on the streets of London to my Shapeways shop. I want to push this further, I like the idea of being able to populate Oxford Street in central London with 1000's of virtual flowers! I am also talking to traditional retailers and exploring ways that the shopping experience can be enhanced through these new technologies. I also recently participated in a couple of Trade Fairs and had many really interesting conversations, brilliant to simply talk to people about the collection and get instant feedback, sometimes the old ways work best!

Shapeways has an excellent interview with Mark, I encourage you to [check it out](#).

Next we sit down and chat with **Alex Delderfield** owner of **Delta Edge**. Delta Edge is filled with wonderful little Minecraft figurines printed in full color sandstone.

## Your shop, Delta Edge is filled with Minecraft figurines. What prompted you to model and print them vs anything else?

After receiving my first 3D print early on in 2011 (which was more of just an experimental test out of interest) I thought for a while about what my first major 3D printing project could be.



I spent a lot of time looking at what other people were making over on the Shapeways forum, in particular the people who were selling successfully (making money with Blender has been something I've been hoping to do for quite some time)

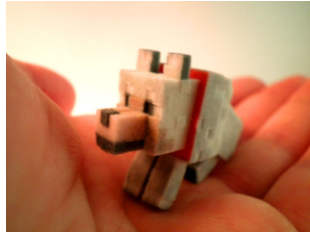


I was playing Minecraft at the time when it occurred to me that a creeper might make a decent 3D printed object, and it was definitely something I would value and want. After a bit of searching around I found there currently weren't any of the quality I wanted, so I decided to whip up one of my own.

After the Creeper model had been completed and I was happy with it, I quickly put together a couple of other figurines to have test-printed as well. About

# How to become a successful Blender Shapeways designer

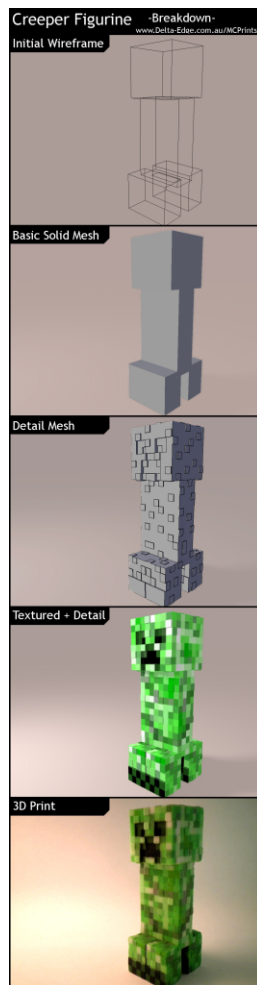
two weeks later the big Shapeways box arrived, and I was more than impressed with the models. Importantly, I knew other people would also share my enthusiasm! By that stage the Minecraft community was growing by millions every month, so I decided to make several more Minecraft models to flesh out the store better, before making the figurines publicly available.



## How do you go about creating each figure?

Since the creatures in Minecraft are very simplistic, the actual creation of the figurine within Blender is pretty simple, especially for someone who has several years of experience using Blender. The tricky part is taking a digital model and making it acceptable to print. Not all digital models are automatically ready to be 3D printed, in fact most digital models probably wouldn't work if you just threw them at a 3D printer and told it to print - there's a lot you need to consider.

For my process however, each figurine starts as a cube. I generally started with the head of the figurine and then added the bodies, arms etc. This was all very simple modeling, just resizing boxes to focus on getting the sizes and proportions correct. Once the (very) basic mesh is done it's then subdivide until the subdivided faces match the



resolution of the low-res blocky texture style Minecraft is known for.

From there I unwrap the model's UV's and add a coloured texture map which lines up exactly with the subdivided faces. I did this so particular 'pixels' on the model could be easily extruded for extra detail. This is where I really felt the quality and depth of the models developed, I was able to add a lot of custom detail which isn't at all present in the game versions of the characters.

Once the main model for the figurine is finished it's duplicated. One of the duplicates is resized to become the larger figurine. The larger one required a lot more work at this point, as I needed to model the hollowed out inside, to save on material and bring the cost down (I mention more about that in the following question).

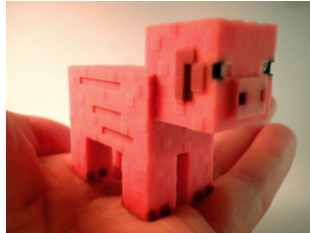
The two versions of the figurine are finally exported from Blender. I then import the model into Netfab for final resizing and checks - Netfab has some handy tools for cutting up a mesh and measuring the thicknesses of walls. It also allows you to calculate the cubic volume of material the object would 'take up' - this is very handy information when it comes to 3D printing. The model is again exported, finally being zipped in a folder with its texture file before being uploaded to Shapeways ready to print.

## Are there any difficulties or obstacles to overcome during the design phase, either in Blender or with Shapeways that you had to solve to obtain good printed results?

There are a few, firstly as an artist you need to understand you're no longer creating just a digital model. You need to be in the mindset that this model is going to be made physically from some material and you need to know what kind of material that will be. The strengths and weaknesses of that material also need to be considered, Shapeways provides some very handy material datasheets which detail the tolerances, max/min wall thicknesses and so on -

# How to become a successful Blender Shapeways designer

everything you need to know about creating a model to be printed in that material.



Also when it comes to 3D printing, since it's such a new technology, the cost of printing a model can quickly become excessive if you're not careful with volumes. Printing out a large solid object will easily cost you hundreds, so optimizing a model and choosing the right size to work at is crucial to get right. The first Creeper model I uploaded was more than \$30 to print - too expensive to be considered a viable option to then sell, with additional mark-up on top. I felt that most people simply wouldn't want to spend that much for a single figurine (I know I wouldn't). This is why I made smaller 'mini' version of the figurine (which drastically brought down the price).

The large figurines were still too expensive though, so I decided they needed to be hollow to save on material costs. I mentioned before that printing a hollow model is much less expensive than a solid one, but this also has major drawbacks as it really adds complication to the model design. I spent a lot of time then pulling the model apart and analyzing it, looking mainly at wall thicknesses, to see how thin I could get the walls without risking a frail or defective model.

Shapeways are good at detecting a defective model before printing however, models can be rejected when uploaded or before being printed if they don't meet specific requirements. There's still that risk however.

**Once you decided on printing Minecraft figurines, how did you go about marketing them?**

Marketing/advertising was something I wanted to make sure I did right. There were several things I thought would be very important - a website to act as a kind of home base for the project, video(s) to show

off the figurines nicely and decent photos for photo and image/art/photography sharing sites. I've also setup a twitter account and Facebook page for people to get more involved with.

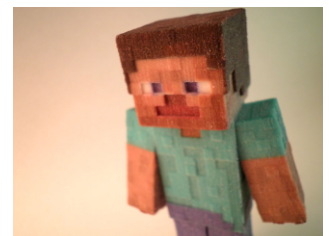
The main thing was having all of these elements setup and ready on the same day, which took a lot of work on planning. By far the best response I've had so far was from Reddit. I posted an album of pictures of the figurines one afternoon and within 48 hours the album had received well over a million views and the post on Reddit had a ton of comments. This huge exposure helped me get the attention of Shapeways as well, who then wrote a designer spotlight article which was featured on the Shapeways homepage for a week. That was certainly great to see, I felt as if my initial marketing had gone well at that point.

I've also thought a lot about holding some contests/give-aways in the coming months. They will more than likely take place on the Facebook page in order to interact with the community/fans a bit more and get more of a buzz going about these figurines. There are also several prominent people/video series in the Minecraft community who will feature the figurines at some point.

I've been lucky enough to be able to organise a few of those so far.

**Do you have plans to expand or add to your Minecraft line of figurines?**

There are some other figurines which have been requested a lot, so I'll be adding a couple more to the shop soon. I also have some other ideas for additions to my Shapeways shop, some Minecraft related and some not.





# How to become a successful Blender Shapeways designer

## How would you describe your experience using Shapeways?

The experience has been great! The fact that we can so easily have access to 3D printing through Shapeways is certainly something I wouldn't have ever imagined. Shapeways then goes a step beyond that by allowing you to setup a shop and have it hosted on their website. I have experienced the odd glitch in the system, but it's always been resolved quickly and professionally.

## Thank you once again for answering my questions.

Thanks for the interview ■

Some additional links for Alex -

### MAIN SITE

<http://www.delta-edge.com.au/MCPrints>

### DIRECT LINK TO SHOP

<http://www.shapeways.com/shops/DeltaEdge>

### FACEBOOK PAGE

<https://www.facebook.com/DeltaEdge.MC-Prints>

### TWITTER

<https://twitter.com/MinecraftPrints>

### PERSONAL TWITTER

[https://twitter.com/Alex\\_ADEdge](https://twitter.com/Alex_ADEdge)

### VIDEOS

<https://www.youtube.com/watch?v=A-cB-KNyxNgU>

<https://www.youtube.com/watch?v=Yb-cNS16x7aU>

And finally we catch up with Marco Alici and his custom Raspberry Pi case. Who promptly decided as soon as he saw the Raspberry Pi, that not only did he want one, but that he wanted to design an attractive case for it.

## What prompted you to design a case for your Raspberry Pi to begin with?

I work as a Mechanical Design Engineer in a company; I'm also a Linux passionate, and I'm vice-president of the local Linux Users Group. While preparing a conference about Open Source software, one of the speakers told me about the Raspberry Pi project. I wanted to get more information from the web, and there I discovered that the board would be sold without a case. I wanted one for me, and as a Mechanical Design Engineer I thought I could easily design a case for my own Raspberry Pi. Since I already knew Shapeways, I knew I could have it made by 3D printing technology. There was very little choice of cases at that time, so I made mine public and available for purchasing, so that other people could give their Raspberry Pi boards a housing.

## What if any preparations/research did you undertake before starting the actual design process?

First of all I searched the Raspberry Pi Foundation website (and any other related) for information about the dimension of the board and the position of the main I/O connectors. For some of them I found more than one source and they were not fully consistent, while some were completely missing (example: the position of the LEDs). So I had to analyze them, mediate and sometimes... guess.

I have to say that my job experience (I mainly design housing for electronic equipments) helped me in this task.



# How to become a successful Blender Shapeways designer

Then I had to solve all the design related problems. I used a CAD software for that purpose, but at every step I made photorealistic renderings using Blender and Yafaray and I published them on my blog and on the Raspberry Pi Foundation forum. The feedback I got has been essential to focus some features and how to implement them.

**Did it require more than one print to get the case to fit properly or did you get it in one take?**

I would have liked to be the first in making a case for Raspberry Pi, so I got the first print before I had a real board in my hands. I was aware that some dimensional errors could have occurred. As soon as I tested it on my board, actually I had to make little corrections here and there, but I was surprised that the first prototype was almost usable. Before that, I only made photorealistic renders using Blender and Yafaray.

**Have you made any modifications since the original design?**

As I said, I used the first print to adjust dimensions, clearances and position of some components. At the same time I wanted to change the design of the upper cooling apertures. After that I made a second print to validate the changes. But I was reasonably sure about it, so I published the model on Shapeways (labelled as "Release Candidate") before getting the second print that actually was good.

**You actually have a wide variety of products in your Shapeways shop, what are your most popular items?**

I have not so much items in my shop: most of them are little gadgets, or things I made for fun (such as the Vuvuzela, that I made during the 2010 FIFA World Cup in South Africa). The real "best seller" is by far the case for Raspberry Pi!

**What is your favorite item so far?**

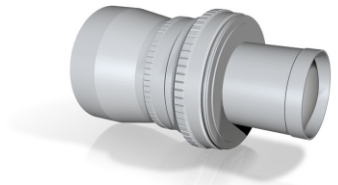
Apart from the case, I like the Zeiss Biogon replica. Actually it was never been printed by Shapeways be-

cause the price was too high (it's a relatively big object). I modelled it in Blender starting from an image to answer to an help request I read on Twitter. Then I 3D-printed it by myself using my own little Reprap Huxley I got in the meantime. The full story is told (in Italian) here: <http://bit.ly/SWEp8R>

**Are there any difficulties or obstacles to overcome during the design phase, either in Blender or with Shapeways that you had to solve to obtain good printed results?**

The main difficulty is related to price: even if Shapeways is not at all the most expensive rapid prototyping service on the market, SLS technology in itself is still too expensive.

Despite of the great effort in the optimization (especially reducing wall thickness and adding cooling apertures even if not necessary) the price of the printed case is a little higher than the board itself. It discourages many potential buyers (most of Raspberry Pi buyers are teenagers or schools, or no-profit organizations), that prefer cheaper alternatives.



**How would you describe your experience using Shapeways?**

I have to say I'm happy using Shapeways: they give a high quality service (I got higher quality only by the more expensive Stereolithography technology), with a wide choice of materials and colours and with a real-time control of costs. There are great people working there, and every time I had doubts or problems I got quick and exhaustive answers by e-mail.

**Thank you once again for answering my questions.**

Thank you, It's a real honor for me to be here! :) ■

# GALLERIA

Blender artworks from the blenderheads



Blender 2 3D - by Metalnat Hayes